Remarks

Claims 1 -20 and 31-32 are pending in this application. Claims 21-30 have been canceled. Applicants believe that the following remarks, in conjunction with the above claim amendments, place the claims in condition for allowance. Applicants respectfully request reconsideration of the application in view of the remarks.

Summary Of Claimed Invention

The invention is directed to a catalyst system for use with internal combustion engines to reduce noxious emissions when the engine is operated at both lean and stoichiometric air/fuel ratios. In one embodiment, claims 1-20, the catalyst system includes two catalysts. One of the catalysts is a lean NOx trap designed specifically to store NOx emissions under lean conditions, reduce the stored NOx during rich operation and convert HC, CO and NOx under stoichiometric operation. This catalyst consists of two zones — a front cerium-free zone containing aluminum oxide, oxides of alkali metals, alkaline earth metals and a high loading of precious metals, and a second zone of oxides of aluminum, alkali metals, alkaline earth metals, rare earth metals, or combinations thereof, and a lower loading of precious metals. The second catalyst is designed specifically to optimize the conversion of HC, CO and NOx under stoichiometric operations. The second catalyst also stores any NOx emitted from the first catalyst during lean operation and converts the stored NOx during the rich purges. The second catalyst contains precious metals, aluminum oxides and a higher concentration of mixed oxides of zirconium and cerium and alkali metals or alkaline earth metals such as barium oxide or magnesium oxide.

The first catalyst is a lean NOx trap, that solves the prior art problem of 1)"NOx release," the release of unreduced NOx from the NOx trap during the transition from lean to rich conditions; and 2) fuel economy reduction that results from frequent purges of the NOx trap. The specific selection of materials in the front zone of the first catalyst minimizes the oxygen storage function and thus the NOx release is minimized and in turn the fuel required to purge the catalyst. More specifically, the first zone of the first catalyst includes a catalyst material PM-Rh, and a metal oxide selected from the group consisting of oxides of

aluminum, alkali metals, alkaline-earth metals, and combinations thereof — the first zone is devoid of cerium. Reduction of oxygen storage capacity of the lean NOx trap is believed to reduce NOx release during the lean-rich transition. Accordingly, in the claimed invention, the first zone must be devoid of cerium. As set forth in the specification on page 11, "catalyst system 10 minimizes the oxygen storage function in the front zone of the first catalyst, so that NOx release is minimized. The reduction of oxygen storage function in the front zone is also believed to minimize the fuel required to purge the catalyst." It is thus necessary that the first or front zone in communication with the exhaust stream — the zone that stores most of the NOx, should be devoid of cerium — to prevent the release of unconverted NOx from the NOx trap during the rich fuel cycle.

Rejection Of Claims 1-20 and 31-32 Under
35 U.S.C. § 102(b) As Being Anticipated By Sung et al.

With the above comments in mind, the Sung prior art reference does not teach every element of the claimed invention. First, regarding claims 1-20, and 31-32, the Sung reference does not teach a first NOx trapping catalyst, having two zones, where one zone is devoid of ceria and another zone can include ceria, wherein the first zone is positioned upstream of the second zone. A zoned catalyst — where each catalyst is positioned next to each other in a horizontal arrangement — is depicted in Figure 3 and is in contrast to the layered structures referred to in Sung. The specification of the application even specifically differentiates between zoned structures and layered structures (see claims 1-20 vs. 21-30). As stated in the Office Action, Sung teaches the use of a layered structure.

Applicants assert that the layered structure in the Sung reference is less effective at minimizing the purge NOx release than the zoned structure in claims 1-20 and 31-32. This is because if there are oxygen storage components, i.e., ceria, in the first layer (as contemplated by Sung, see col. 8, ll. 54-57), the exothermic reaction generated in that first layer during the lean-to-rich excursion will be able to affect the layer above it due to the close contact of the two layers. As a result, NOx stored in the second layer may be released — contrary to the goal of "minimizing the purge NOx release." In the zoned structure in claims 1-20 and 31-32, heat generated in the second zone will not travel upstream and cause NOx to

be released from the first zone. Accordingly, the use of zoning in the asserted claims minimizes heat transfer from one zone to another, and thus minimizes the purge NOx release. As a result of this structural difference, the Sung reference does not anticipate claims 1-20 and 31-32.

Second, the Sung reference teaches that the upstream catalyst is a three-way conversion catalyst, such catalysts cannot optimize storage of NOx under lean air/fuel ratios as required by the claims. Per the claims, the upstream catalyst in the claimed system is defined as a lean NOx trap. Third, the Sung reference teaches the use of an oxygen storage component such as ceria, in the top layer of the upstream catalyst. (Sung patent, column 9, ll. 20-28.) Accordingly, the Sung reference fails to disclose a first catalyst including a first zone that is devoid of ceria, as required by claims 1-20 and 31-32. Fourth, the invention in claims 1-20 and 31-32 calls for the first zone of the first catalyst to be upstream from the second zone of the first catalyst, and further that this first zone is devoid of cerium, so that NOx is not released. Because these claim elements are missing, the Sung reference fails to constitute an anticipatory reference.

Sung should also not be considered an anticipatory reference as the art does not teach the claimed subject matter with **sufficient specificity** to constitute an anticipation under 35 U.S.C. § 102. As the Examiner has stated, the Sung "reference does not disclose the exact amounts of the components required by the instant claims." Applicants disagree with the Examiner's assertion that the subject matter as a whole would have been obvious to one of ordinary skill in the art. Applicants note that a *prima facie* case of obviousness is rebutted, if the art in any material respect teaches away from the claimed invention. *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997).

In this case, the Sung reference teaches away from the instant claims by teaching a first upstream layer that can optionally delete the first platinum and/or first rhodium component. In the present claims, the PM-Rh component is used to reduce the stored NOx of the first NOx trapping catalyst — and is thus a necessary component — not one that can optionally be deleted. Because the first catalyst in Sung is a three-way-catalyst, the Sung reference teaches away from the need for the PM-Rh component of the present invention. Sung emphasizes the use of Pd — which is consistent with Sung's intent to use the catalyst as

just a three-way catalyst– not a lean NOx trapping catalyst. Likewise, the Sung reference teaches that the use of (1) a first alkaline earth metal component, (2) a first zirconium component, and (3) a first rare earth metal component are optional and may be deleted from the first catalyst, and thus also teaches away from the present invention, which specifically requires a metal oxide in the second zone of the first catalyst selected from the group consisting of alkali metals, alkaline earth metals, rare earth metals and combinations thereof. Here again, because the first layer in the Sung upstream catalyst is not intended to serve as a NOx trapping catalyst, the Sung reference teaches away from the present claims. Accordingly, Applicants assert that the claimed invention is neither anticipated nor rendered obvious by the Sung reference.

Rejection Of Claims 1-20 and 31-32 Under
35 U.S.C. § 103(a) As Being Unpatentable In View Of Sung et al.

The Sung reference also fails to render the present invention obvious. First, the Sung reference teaches that the upstream catalyst is a three-way conversion catalyst. In the present invention, the first or upstream catalyst functions as a lean NOx trap — not a three-way catalyst. Rather, it is the downstream catalyst, in the present invention that functions as a three-way catalyst. Moreover, the two problems identified by the present invention, namely, 1)"NOx release," the release of unreduced NOx from the NOx trap during the transition from lean to rich conditions; and 2) fuel economy reduction that results from frequent purges of the NOx trap, are neither mentioned nor solved in the Sung reference. Applicants understand that the solution to both of these problems involves the specific selection of materials in the two zones of the first catalyst, and in particular the existence of a cerium-free first zone — to solve the above mentioned problems. Accordingly, because the Sung reference does not include a first lean NOx trap catalyst, that includes a cerium-free zone, the Sung reference cannot render the present invention obvious.

Rejection Of Claim 31 Under 35 U.S.C. § 102(b)
As Being Anticipated By EP 1 108 863 A2

The EP 1 108 863 A2 reference fails to teach one single catalyst having two zones, as required by the claim 31. Claim 31 is directed to a catalyst with two zones whose composition is defined — in this context "a catalyst" means one catalyst — in contrast to claims 1-20 which refer to the use of more than one catalyst. The specific use of zoning as set forth in claim 31 requires a single catalyst configuration, as each zone works in conjunction with the next zone to store NOx and reduce NOx as necessary so that the catalyst has the ability to function under both lean and stoichiometric operations. Accordingly, the EP references fails to constitute an anticipatory reference. Further, the EP reference suggests that "rare earth element(s) (i.e. cerium), zirconium and/or the like may be added to the porous carrier" of the NOx reducing catalyst — teaching away from the ceria-free zone required by claim 31. (Page 6, ll. 51-54.) Thus, the EP reference does not anticipate nor render claim 31 obvious.

Rejection Of Claim 31 Under 35 U.S.C. § 102(b)
As Being Anticipated By Deeba et al.

The Deeba et al. reference also fails to teach a single catalyst having two zones. As set forth with respect to the EP reference, the structure of the claimed invention — to have multiple zones within one single catalyst — assists in the catalyst's ability to function both under lean and stoichiometric operations. Thus, because Deeba fails to include a single catalyst with multiple zones, it can not constitute an anticipatory reference. Further, the top layer of catalytic layer E, calls for no rhodium — contrary to the claimed invention which requires a PM-Rh catalyst mixture for all of the zones. The Examiner points out this discrepancy in the Office Action, page 9. Accordingly, the Deeba reference does not anticipate nor render claim 31 obvious.

Conclusion

For the foregoing reasons, Applicants believe that the Office Action of June 20, 2005 has been fully responded to and, in view of the amendment and remarks, that the application is in condition for allowance. Applicants respectfully request such an allowance and invite the Examiner to contact the undersigned with any questions.

Respectfully submitted,
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